PATENT
3430-0131P

IN THE U.S. PATENT AND TRADEMARK OFFICE

In Re Application of		Before the Board of Appeals	
Kwang-Jo Hwang		Appeal No.	
Appl. No.:	09/648,111	Group:	2815
Filed:	August 25, 2000	Examiner:	N.D. Richards
Conf. No.:	5562		

For: METHOD OF PATTERNING A METAL LAYER IN A SEMICONDUCTOR DEVICE

APPEAL BRIEF ON BEHALF OF APPELLANT UNDER 37 C.F.R. §41.37

TABLE OF CONTENTS

MS APPEAL BRIEF - PATENTS
PATENT
3430-0131P

IN THE U.S. PATENT AND TRADEMARK OFFICE

In Re Application of		Before the Board of Appeals	
Kwang-Jo Hwang		Appeal No.	
Appl. No.:	09/648,111	Group:	2815
Filed:	August 25, 2000	Examiner:	N.D. Richards
Conf. No.:	5562		

For: METHOD OF PATTERNING A METAL LAYER IN A SEMICONDUCTOR DEVICE

APPEAL BRIEF ON BEHALF OF APPELLANT UNDER 37 C.F.R. §41.37

MS APPEAL BRIEF- PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

June 20, 2006

Dear Sir:

This is an Appeal from the Rejection of September 20, 2005 of claims 1-11 and 13-31 in the above-identified application.

I. REAL PARTY IN INTEREST

As evidenced by the Assignment filed January 2, 2001, and recorded at Reel 011391, Frames 0076-0078 the Real Party In Interest in connection with the present application is the Assignee of record, LG.PHILIPS LCD CO. LTD., 20 Yoido-dong, Youngdungpo-gu, Seoul, Republic of Korea.

II. RELATED APPEALS AND INTERFERENCES

There are no pending Appeals or Interferences related to the present application known to the Appellant or the Appellant's Legal Representatives.

III. STATUS OF CLAIMS

Claims 1-11 and 13-31 are pending in the application. Claims 1-11 and 13-31 stand rejected.

IV. STATUS OF AMENDMENTS

An Amendment Under 37 C.F.R. § 1.111 was filed on August 23, 2001. An Amendment Under 37 C.F.R. § 1.116 was filed on January 16, 2002, which was entered by the Request for Continued Examination (RCE) filed March 18, 2002. An Amendment Under 37 C.F.R. § 1.111 was filed on August 7, 2002. An Amendment Under 37 C.F.R. § 1.116 was filed on December 2, 2002, which was entered by the RCE filed January 9, 2003. An Amendment Under 37 C.F.R. § 1.111 was filed on May 27, 2003. An Amendment Under 37 C.F.R. § 1.116 was filed on September 26, 2003, which was entered by the RCE filed December 24, 2003. An Amendment Under 37 C.F.R. § 1.111 was filed on June 15, 2004. An Amendment Under 37 C.F.R. § 1.116 was filed on December 3, 2004, which was entered by the RCE filed January 5, 2005. An Amendment Under 37 C.F.R. § 1.111 was filed on July 5, 2005. An Amendment Under 37 C.F.R. § 1.116 was filed on December 20, 2005, which was entered for purposes of appeal in the Advisory Action mailed January 3, 3006.

Accordingly, all amendments presented by the Appellant have been entered.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention pertains to a method of manufacturing a liquid crystal display device that includes forming a switching element on a substrate (e.g., page 4, line 5 of the present specification); forming a passivation layer over the substrate (e.g., page 4, lines 5-6); depositing a metal layer on the passivation layer (e.g., page 5, line 6); forming a photoresist pattern on a surface of the metal layer, such that an upper portion of the metal layer is exposed (e.g., page 5, lines 7-8). The method also includes treating the exposed portion of the metal layer with a first plasma, prior to any step of etching the photoresist pattern, and prior to any step of etching the metal layer, thereby lowering an internal binding force in the exposed portion of the metal layer to increase the subsequent etch rate of the metal layer (e.g., page 6, line 15 to page 7, line 8). Etching the treated portion of the metal layer forms a pixel electrode (e.g., page 4, lines 9-10, page 7, lines 5-6). Also, the depositing of a metal layer on the passivation layer, forming a photoresist pattern, and treating the exposed portion of the metal layer are sequentially performed (e.g., page 6, lines 8-14).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The first issue presented for review is whether U.S. Patent No. 5,771,110 to Hirano et. al. (Hirano) in view of U.S. Patent No. 6,133,145 to Chen (Chen) suggest all the elements of claims 1, 2, 5-9, 11,13, 15, 16, 20-22, 24 and 28-31 sufficient to support an obviousness rejection under 35 U.S.C. § 103(a).

The second issue presented for review is whether the combination of Hirano, Chen and further in view of U.S. Patent No. 5,968,847 to Ye et al. (Ye) suggest all the elements of claims 10, 17-19 and 25-27 to support an obviousness rejection under 35 U.S.C. § 103(a).

The third issue presented for review is whether the combination of Hirano, Chen and further in view of JP 361002368 to Muraguchi et al. (Muraguchi) suggest all the elements of claims 3, 4, 14 and 23 to support an obviousness rejection under 35 U.S.C. § 103(a).

VII. ARGUMENT

VII-A. The Present Invention and its Advantages

The present invention pertains to a method for patterning a metal layer in a semiconductor device in which the plasma etch rate can be twice as high as in the conventional art (specification at page 7, lines 7-8 and Figure 7). This novel result is obtained, in part, by depressing the binding force of the metal layer. That is, if hydrogen gas reacts with oxygen in an indium tin oxide (ITO) metal layer, water forms to leave only indium, thus reducing the binding force (specification at page 6, lines 16-21).

The invention has many embodiments, and a typical embodiment can be found in instant claim 1:

> 1. A method of manufacturing a liquid crystal display device, comprising:
> forming a switching element on a substrate;
> forming a passivation layer over the substrate;
> depositing a metal layer on the passivation layer;
> forming a photoresist pattern on a surface of the metal layer, such that an upper portion of said metal layer is exposed;
> treating the exposed portion of said metal layer with a first plasma, prior to any step of etching said photoresist pattern, and prior to any step of etching said metal layer, thereby lowering an internal binding force in the exposed portion of said metal layer to increase a subsequent etch rate of said metal layer; and
> etching the treated portion of said metal layer to form a pixel electrode, wherein said depositing a metal layer on the passivation layer, forming a photoresist pattern, and treating the exposed portion of said metal layer are sequentially performed.

Independent claims 22, 30 and 31 set forth additional embodiments of the invention where exposing to a plasma or a gas lowers the internal binding force to thus increase the subsequent etch rate of a metal layer.

VII-B. Distinctions of the Invention Over Hirano and Chen

When a rejection is based on 35 USC §103, what is in issue in such a rejection is "the invention as a whole," not just a few features of the claimed invention. Under 35 U.S.C. §103, "[a] patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter *as a whole* would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." The determination under §103 is whether the claimed invention *as a whole* would have been obvious to a person of ordinary skill in the art at the time the invention was made. See *In re O'Farrell*, 853 F.2d 894, 902, 7 USPQ2d 1673, 1680 (Fed. Cir. 1988). In determining obviousness, the invention must be considered as a whole and the claims must be considered in their entirety. See *Medtronic, Inc. v. Cardiac Pacemakers, Inc.*, 721 F.2d 1563, 1567, 220 USPQ 97, 101 (Fed. Cir. 1983).

In rejecting claims under 35 USC 103, it is incumbent on the examiner to establish a factual basis to support the legal conclusion of obviousness. See, *In re Fine*, 837 F.2d 1071, 1073, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). In so doing, the examiner is expected to make the factual determinations set

forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966), and to provide a reason why one of ordinary skill in the pertinent art would have been led to modify the prior art or to combine prior art references to arrive at the claimed invention. Such reasoning must stem from some teaching, suggestion or implication in the prior art as a whole or knowledge generally available to one having ordinary skill in the art. *Uniroyal Inc. v. F-Wiley Corp.*, 837 F.2d 1044, 1051, 5 USPQ2d 1434, 1438 (Fed. Cir. 1988), *cert. denied*, 488 U.S. 825 (1988); *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 293, 227 USPQ 657, 664 (Fed. Cir. 1985), *cert. denied*, 475 U.S. 1017 (1986); *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). These showings by the examiner are an essential part of complying with the burden of presenting a *prima facie* case of obviousness. Note, *In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). The mere fact that the prior art may be modified in the manner suggested by the examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1783-84 (Fed. Cir. 1992).

Further, the rigorous burden placed upon the Examiner for establishing *prima facie* obviousness has been emphasized by the United States Court of Appeals for the Federal Circuit in *In re Sang Su Lee*, 277 F.3d 1338, 61 USPQ2d 1430 (Fed. Cir. 2002). In *Sang Su Lee*, the court states:

> As applied to the determination of patentability *vel non* when the issue is obviousness, "it is fundamental that rejections under 35 U.S.C. §103 must be based on evidence comprehended by the language of that section." *In re Grasselli*, 713 F.2d 731, 739, 218 USPQ 769, 775 (Fed. Cir. 1983). The essential factual evidence on the issue of obviousness is set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966) and extensive ensuing precedent. The patent examination process centers on prior art and the analysis thereof. When patentability turns on the question of obviousness, the search for and analysis of the prior art includes evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness. *See, e.g., McGinley v. Franklin Sports, Inc.*, 262 F.3d 1339, 1351-52, 60 USPQ2d 1001, 1008 (Fed. Cir. 2001) ("the central question is whether there is reason to combine [the] references," a question of fact drawing on the Graham factors).

The need for specificity pervades this authority. *See, e.g., In re Kotzab*, 217 F.3d 1365, 1371, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000) ("particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed"); *In re Rouffet*, 149 F.3d 1350, 1359, 47 USPQ2d 1453, 1459 (Fed. Cir. 1998) ("even when the level of skill in the art is high, the Board must identify specifically the principle, known to one of ordinary skill, that suggests the claimed combination. In other words, the Board must explain the reasons one of ordinary skill in the art would have been motivated to select the references and to combine them to render the claimed invention obvious."); *In re Fritch*, 972 F.2d 1260, 1265, 23 USPQ2d 1780, 1783 (Fed. Cir. 1992) (the examiner can satisfy the burden of showing

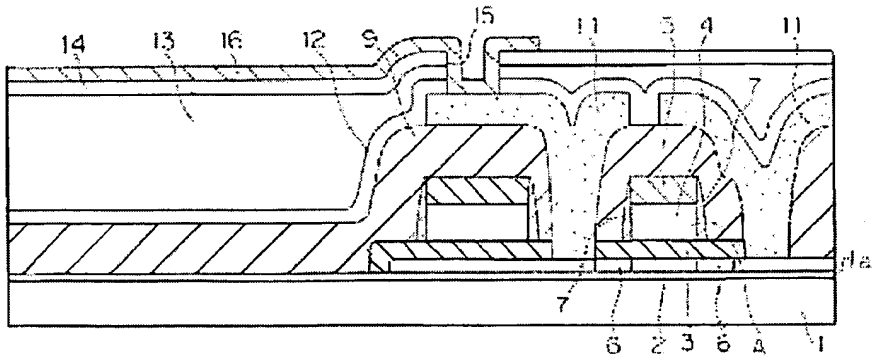
obviousness of the combination "only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references"). *In re Sang Su Lee* at 277 F.3d 1342.

None of the applied art teaches or suggests reducing the binding force in the metal layer so as to enhance the etch rate.

Hirano pertains to a method of manufacturing a liquid crystal display device that includes etching a portion of a metal layer to form a pixel electrode. Hirano fails to disclose reducing the binding force in the metal layer so as to enhance the etch rate.

At page 2 of the Office Action mailed February 3, 2005, the Examiner points to Figure 15 of Hirano and the discussion at column 12, lines 54-60 of Hirano. Figure 15 of Hirano is reproduced below.

Fig. 15



Hirano at column 12, lines 54-60 states:

> Step **15** (see FIG. **15**): In order to finally work the ITO film **16** into an electrode shape, a resist pattern is formed on the ITO film **16**, which in turn is etched by RIE employing hydrogen bromide gas (HBr), and the gas is switched to chlorine gas (Cl_2) when exposure of the silicon oxide film **14** is started, for continuously performing the etching to the last as such.

That is, Hirano teaches nothing about reducing the internal binding force.

At pages 2 and 3 the Office Action mailed February 3, 2005 (relied upon by the Examiner), the Examiner unequivocally admits to certain failures in Hirano, including the failure to disclose treating the exposed portion of the metal layer with a first plasma prior to etching (Office Action of February 3, 2005 at page 2, lines 21-22). The Examiner then turns to Chen.

Chen pertains to a method to increase the etch rate selectivity between metal and photoresist. Figure 5 of Chen (reproduced below) shows a structure that includes an aluminum-based metal layer **10a**, and a stack formed from a titanium nitride layer **11b** and a photoresist shape **12b**.

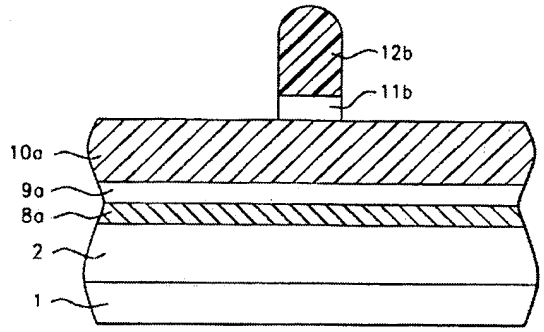


FIG. 5

Chen at column 4, lines 16-20 describes a plasma treating during reactive ion etch (RIE) in a nitrogen atmosphere: "At this stage of the RIE procedure, an in situ, plasma treatment, is performed in a nitrogen containing ambient, resulting in a surface of photoresist shape **12b**, that will be ***more resistant*** to the subsequent second cycle, or main etch cycle, of the RIE procedure." (Emphasis added).

That is, Chen uses a plasma treatment to render the material more resistant to etch. In contrast, the present invention reduces the internal binding force of the material in order to enhance the etch rate. Chen thus teaches away from one of the important objects of the present invention.

A prior art reference must be considered in its entirety, i.e., as a *whole*, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984). It is improper to combine references

where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983). A *prima facie* case of obviousness may also be rebutted by showing that the art, in any material respect, teaches away from the invention. *In re Geisler*, 116 F.3d 1465, 1471, 43 USPQ2d 1362, 1366 (Fed. Cir. 1997).

Further, at page 3, lines 2-5 of the Office Action of February 3, 2005, the Examiner posits a fundamentally different etch control mechanism than that of the present invention:

> It would have been obvious to one of ordinary skill in the art at the time of the present invention to use the treating method of Chen in the method of Hirano in order to slow the removal rate of the resist pattern by causing the resist pattern to become more resilient as taught by Chen in column 1, lines 29-35 and column 4, lines 17-24.

However, the present invention does not modify the properties of the resist. In contrast, the present invention modifies the properties, i.e., internal binding force, of the metal layer. That is, Chen at column 1, lines 29-35 describes using plasma to modify the "photoresist shape." As a result, adapting the plasma of Chen to modify the metal impermissibly changes the principle of operation of Chen. If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA

1959).

At page 3, lines 7-14 of the Office Action of February 3, 2005, the Examiner then asserts that lowering the internal binding force in the metal layer is a result effective variable and is a necessary result of combining Chen with Hirano. By this, the Examiner tacitly admits that the combination of Chen with Hirano fails to fairly disclose or suggest each and every element of the independent claims. To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All the words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970).

Further, a particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977) (The claimed wastewater treatment device had a tank volume to contractor area of 0.12 gal./sq. ft. The prior art did not recognize that treatment capacity is a function of the tank volume to contractor ratio, and therefore the parameter optimized was not recognized in the art to be a result-effective variable.). See also *In re Boesch*, 617 F.2d 272, 205 USPQ 215

(CCPA 1980) (prior art suggested proportional balancing to achieve desired results in the formation of an alloy).

In this case, neither Hirano nor Chen recognized internal binding force as a parameter that can be manipulated to influence the etch rate. As a result, one of ordinary skill in the art would not recognize internal binding force as an optimizable parameter from the teachings of Hirano and Chen.

Accordingly, one having ordinary skill in the art would not be motivated by the teachings of Hirano and Chen to produce the invention of independent claims 1, 22, 30 and 31. A *prima facie* case of obviousness has not been made. Claims depending upon claims 1, 22, 30 and 31 are patentable for at least the above reasons.

VII-C. Distinctions Of The Invention Over Hirano, Chen and Ye

Hirano and Chen have been discussed above. At page 9 of the Office Action mailed February 3, 2005 (relied upon by the Examiner), the Examiner unequivocally admits that Hirano and Chen fail to disclose the combination of HBr and CH_4 as plasma gases. The Examiner turns to Ye for these teachings.

However, these teachings of Ye fail to address the deficiencies of Hirano and Chen in suggesting a claimed embodiment of the present invention. A *prima facie* case of obviousness has thus not been made over Hirano Chen and Ye.

VII-D. Distinctions Of The Invention Over Hirano, Chen and Muraguchi

Hirano and Chen have been discussed above. At page 11 of the Office Action mailed February 3, 2005 (relied upon by the Examiner), the Examiner unequivocally admits that Hirano and Chen fail to disclose treating to exposed portion of the metal layers includes using a reactive gas. The Examiner turns to Muraguchi for these teachings.

However, these teachings of Muraguchi fail to address the deficiencies of Hirano and Chen in suggesting a claimed embodiment of the present invention. A *prima facie* case of obviousness has thus not been made over Hirano Chen and Muraguchi.

VII-E. Unexpected Results

Even if one assumes *arguendo* that the applied art references are sufficient to allege *prima facie* obviousness over the present invention, this obviousness would be fully rebutted by the unexpected results displayed by the present invention. These unexpected results, arising from lowering the internal binding force, are clearly shown in Figure 7 of the present invention, which is reproduced below.

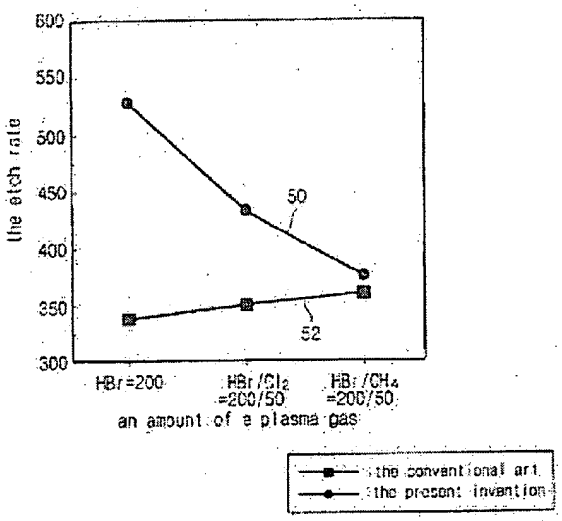


FIG.7

As is shown in Figure 7 of the present invention (and as discussed at page 7 of the specification), the present invention shown in curve 50 achieves an etch rate about twice as high as that of the conventional technology. As a result, lowering the internal binding force of the metal layer achieves results that are truly unexpected when compared to the applied art references (which teach nothing about internal binding force.).

VII-F. Summary

The inventive method for manufacturing a liquid crystal display device lowers the internal binding energy of the metal layer to thereby enhance the

etch rate. None of the applied art references of Hirano, Chen, Ye and Muraguchi teach or suggest lowering the internal binding energy to enhance etch rate. Chen also teaches away from the present invention. The Examiner has thus failed to establish a *prima facie* case of obviousness over either any combination of Hirano, Chen, Ye and Muraguchi. The present invention also shows unexpected results over the conventional art technology typified by Hirano, Chen, Ye and Muraguchi.

Accordingly, reversal of the Examiner's rejection of claims 1-11 and 13-31 based on the above arguments is respectfully requested.

CONCLUSION

The Appellant has demonstrated that the Examiner has failed to successfully allege that the rejected claims are *prima facie* obvious. It is clear that the inventive method for manufacturing a crystal display device represents a truly inventive display technology. For the reasons advanced above, it is respectfully submitted that all claims in this application are allowable. Thus, favorable reconsideration and reversal of the Examiner's rejections of claims 1-11 and 13-31 under 35 U.S.C. § 103(a), by the Honorable Board of Patent Appeals and Interferences, are respectfully solicited.

The required Appeal Brief fee in the amount of $500.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and further replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fee required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By: Esther Chong

Esther H. Chong
Reg. No.: 40,953

P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

EHC/REG:gf
REC

Attachments: VIII CLAIMS APPENDIX
IX EVIDENCE APPENDIX
X RELATED PROCEEDINGS APPENDIX

VIII

CLAIMS APPENDIX

1. (Previously Presented) A method of manufacturing a liquid crystal display device, comprising:

forming a switching element on a substrate;

forming a passivation layer over the substrate;

depositing a metal layer on the passivation layer;

forming a photoresist pattern on a surface of the metal layer, such that an upper portion of said metal layer is exposed;

treating the exposed portion of said metal layer with a first plasma, prior to any step of etching said photoresist pattern, and prior to any step of etching said metal layer, thereby lowering an internal binding force in the exposed portion of said metal layer to increase a subsequent etch rate of said metal layer; and

etching the treated portion of said metal layer to form a pixel electrode, wherein said depositing a metal layer on the passivation layer, forming a photoresist pattern, and treating the exposed portion of said metal layer are sequentially performed.

2. (Original) The method of claim 1, wherein the switching element is a thin film transistor.

3. (Original) The method of claim 1, wherein the step of treating the exposed portion of the metal layer includes,

using a reactive gas to lower a binding force in the exposed portion.

4. (Original) The method of claim 3, wherein the reactive gas includes H_2 plasma gas.

5. (Original) The method of claim 1, wherein the step of treating the exposed portion of the metal layer includes,

using a non-reactive gas to lower a binding force in the exposed portion.

6. (Original) The method of claim 5, wherein the non-reactive gas includes Ar or N_2 plasma gas.

7. (Original) The method of claim 1, wherein the step of etching the metal layer involves a dry-etching technique.

8. (Original) The method of claim 7, wherein the step of etching the

metal layer includes,

etching the metal layer with HBr plasma gas.

9. (Original) The method of claim 7, wherein the step of etching the metal layer includes,

etching the metal layer with a composition of HBr plasma gas and Cl_2 plasma gas.

10. (Original) The method of claim 7, wherein the step of etching the metal layer includes,

etching the metal layer with a composition of HBr plasma gas and CH_4 plasma gas.

11. (Original) The method of claim 1, wherein the metal layer includes one of indium tin oxide (ITO) and indium zinc oxide (IZO).

12. (Canceled)

13. (Previously Presented) The method of claim 30, wherein the first gas is a reactive gas.

14. (Original) The method of claim 13, wherein the reactive gas includes H_2 plasma gas.

15. (Previously Presented) The method of claim 30, wherein the first gas is a non-reactive gas.

16. (Original) The method of claim 15, wherein the non-reactive gas includes Ar or N_2 plasma gas.

17. (Previously Presented) The method of claim 30, wherein the at least one second gas includes HBr plasma gas.

18. (Previously Presented) The method of claim 30, wherein the at least one second gas includes a composition of HBr plasma gas and Cl_2 plasma gas.

19. (Previously Presented) The method of claim 30, wherein the at least one second gas the at least one second gas includes a composition of HBr plasma gas and CH_4 plasma gas.

20. (Previously Presented) The method of claim 30, wherein the metal layer includes one of indium tin oxide (ITO) and indium zinc oxide (IZO).

21. (Previously Presented) The method of claim 30, further comprising:

removing the photoresist pattern from the pixel electrode.

22. (Previously Presented) A method of patterning a metal layer, comprising:

depositing a metal layer over a substrate;

forming a mask on a surface of the metal layer, leaving an upper portion of said metal layer uncovered;

exposing the uncovered portion of said metal layer to a first plasma, prior to any step of etching said metal layer, thereby lowering an internal binding force in the uncovered portion to increase a subsequent etch rate of said metal layer; and

etching the uncovered portion of said metal layer with a second plasma to form a metal pattern, wherein said depositing a metal layer over a substrate, forming a mask on a surface of the metal layer, and exposing the uncovered portion of said metal layer are sequentially performed.

23. (Original) The method of claim 22, wherein the first plasma includes H_2 plasma gas.

24. (Original) The method of claim 22, wherein the first plasma includes Ar or N_2 plasma gas.

25. (Original) The method of claim 22, wherein the second plasma includes HBr plasma gas.

26. (Original) The method of claim 22, wherein the second plasma includes a composition of HBr plasma gas and Cl_2 plasma gas.

27. (Original) The method of claim 22, wherein the second plasma includes a composition of HBr plasma gas and CH_4 plasma gas.

28. (Original) The method of claim 22, wherein the metal layer includes one of indium tin oxide (ITO) and indium zinc oxide (IZO).

29. (Original) The method of claim 22, wherein the metal pattern includes a pixel electrode of a display device.

30. (Previously Presented) A method of manufacturing a pixel electrode in a liquid crystal display device, comprising:

depositing a metal layer on a passivation layer which partially covers a transistor;

forming a photoresist pattern on a surface of the metal layer, leaving an upper portion of the metal layer uncovered;

exposing the uncovered portion of said metal layer to at least one first gas, prior to any step of etching said photoresist pattern and prior to any step of etching said metal layer, to lower an internal binding force in the uncovered portion to increase a subsequent etch rate of said metal layer; and

etching the uncovered portion of said metal layer with at least one second gas to form a pixel electrode, wherein said depositing a metal layer on the passivation layer, forming a photoresist pattern, and exposing the uncovered portion of said metal layer are sequentially performed.

31. (Previously Presented) A method of manufacturing a pixel electrode in a liquid crystal display device, comprising:

depositing a metal layer on a passivation layer which partially covers a transistor;

forming a photoresist pattern on a surface of the metal layer, leaving an upper portion of the metal layer uncovered;

exposing the uncovered portion of said metal layer to at least one first gas, prior to any step of etching, to lower an internal binding force in the uncovered portion to increase a subsequent etch rate of said metal layer; and

etching the uncovered portion of said metal layer with at least one second gas to form a pixel electrode, wherein said depositing a metal layer on the passivation layer, forming a photoresist pattern, and exposing the uncovered portion of said metal layer are sequentially performed.

IX

EVIDENCE APPENDIX

(Not Applicable)

X

RELATED PROCEEDINGS APPENDIX

(Not Applicable)